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UTILITY PATENT APPLICATION TRANSMITTAL

(Large Entity)

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Docket No.
YO9-97-348C

Total Pages in this Submission

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TO THE ASSISTANT COMMISSIONER FOR PATENTS

Box Patent Application
Washington, D.C. 20231

Transmitted herewith for filing under 35 U.S.C. 111(a) and 37 C.F.R. 1.53(b) is a new utility patent application for an invention entitled:

SUMMARY FRAMES IN VIDEO

and invented by:

Boon-Lock Yeo and Minerva Ming-Yee Yeung

If a **CONTINUATION APPLICATION**, check appropriate box and supply the requisite information:

Continuation Divisional Continuation-in-part (CIP) of prior application No.: 08/956,417

Which is a:

Continuation Divisional Continuation-in-part (CIP) of prior application No.: _____

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Enclosed are:

Application Elements

1. Filing fee as calculated and transmitted as described below
2. Specification having 21 pages and including the following:
 - a. Descriptive Title of the Invention
 - b. Cross References to Related Applications (*if applicable*)
 - c. Statement Regarding Federally-sponsored Research/Development (*if applicable*)
 - d. Reference to Microfiche Appendix (*if applicable*)
 - e. Background of the Invention
 - f. Brief Summary of the Invention
 - g. Brief Description of the Drawings (*if drawings filed*)
 - h. Detailed Description
 - i. Claim(s) as Classified Below
 - j. Abstract of the Disclosure

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Application Elements (Continued)

3. Drawing(s) (*when necessary as prescribed by 35 USC 113*)
a. Formal Number of Sheets 12
b. Informal Number of Sheets _____

4. Oath or Declaration
a. Newly executed (*original or copy*) Unexecuted
b. Copy from a prior application (37 CFR 1.63(d)) (*for continuation/divisional application only*)
c. With Power of Attorney Without Power of Attorney
d. DELETION OF INVENTOR(S)
Signed statement attached deleting inventor(s) named in the prior application,
see 37 C.F.R. 1.63(d)(2) and 1.33(b).

5. Incorporation By Reference (*usable if Box 4b is checked*)
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under
Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby
incorporated by reference therein.

6. Computer Program in Microfiche (*Appendix*)

7. Nucleotide and/or Amino Acid Sequence Submission (*if applicable, all must be included*)
a. Paper Copy
b. Computer Readable Copy (*identical to computer copy*)
c. Statement Verifying Identical Paper and Computer Readable Copy

Accompanying Application Parts

8. Assignment Papers (*cover sheet & document(s)*)

9. 37 CFR 3.73(B) Statement (*when there is an assignee*)

10. English Translation Document (*if applicable*)

11. Information Disclosure Statement/PTO-1449 Copies of IDS Citations

12. Preliminary Amendment

13. Acknowledgment postcard

14. Certificate of Mailing
 First Class Express Mail (*Specify Label No.*): HAND DELIVERED

UTILITY PATENT APPLICATION TRANSMITTAL
(Large Entity)

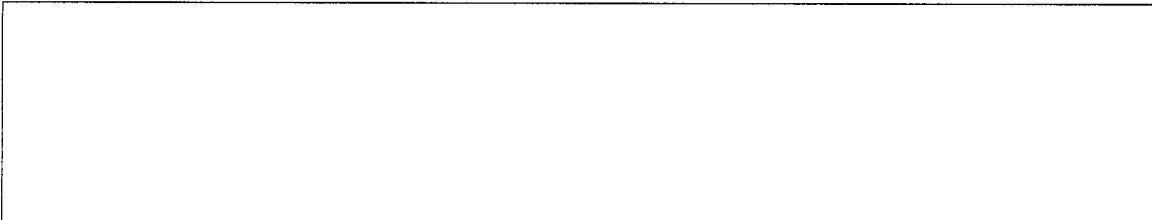
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Accompanying Application Parts (Continued)

15. Certified Copy of Priority Document(s) (*if foreign priority is claimed*)

16. Additional Enclosures (*please identify below*):


Fee Calculation and Transmittal

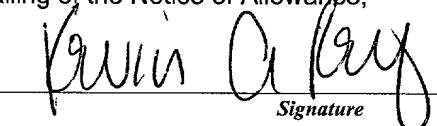
CLAIMS AS FILED

For	#Filed	#Allowed	#Extra	Rate	Fee
Total Claims	15	- 20 =	0	x \$18.00	\$0.00
Indep. Claims	3	- 3 =	0	x \$78.00	\$0.00
Multiple Dependent Claims (check if applicable)	<input type="checkbox"/>				\$0.00
				BASIC FEE	\$690.00
OTHER FEE (specify purpose)					\$0.00
				TOTAL FILING FEE	\$690.00

A check in the amount of _____ to cover the filing fee is enclosed.

The Commissioner is hereby authorized to charge and credit Deposit Account No. **50-0510/IBM** as described below. A duplicate copy of this sheet is enclosed.

- Charge the amount of **\$690.00** as filing fee.
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- Charge any additional filing fees required under 37 C.F.R. 1.16 and 1.17.
- Charge the issue fee set in 37 C.F.R. 1.18 at the mailing of the Notice of Allowance, pursuant to 37 C.F.R. 1.311(b).



Signature

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Dated: September 27, 2000

CC:

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of
Boon-Lock YEO et al.
Filed: Concurrently herewith

Continuation of:

For: SUMMARY FRAMES IN VIDEO

Assistant Commissioner for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Sir:

Prior to examination on the merits, please amend to above identified patent application as follows:

IN THE SPECIFICATION:

On page 1, line 2, after the title, insert the following:

CROSS REFERENCE TO RELATED APPLICATIONS

This is a continuation of U.S. Patent Application Serial No. 08/956,417, now U.S. Patent _____, filed on October 23, 1997, the contents of which are herein incorporated by reference.--

IN THE CLAIMS:

Please cancel claims 1-20 and substitute therefore the following:

- 1 21. A video viewing system, comprising:
 - 2 means for selecting a programming channel containing video
 - 3 program in progress;
 - 4 a display screen for viewing a video program in progress;
 - 5 at least one summary frame also displayed on said display
 - 6 screen along with said video program in progress at a same time when
 - 7 said programming channel is selected, said at least one summary frame
 - 8 comprising a past frame from said video program in progress.

- 1 22. A video viewing system as recited in claim 21 wherein said
2 selecting said at least one summary frame displays a video segment on
3 said viewing screen corresponding to said summary frame.

- 1 23. A video viewing system as recited in claim 21 comprising a
2 plurality of said summary frames each corresponding to a past frame
3 from said video program in progress.

- 1 24. A video viewing system as recited in claim 21 further
2 comprising at least one preview frame comprising a future frame from
3 said video program in progress.

- 1 25. A user interactive video viewing system, comprising:
 - 2 a display screen for viewing a video program;
 - 3 at least one summary frame displayed on said display screen at
 - 4 a same time with said video program, said at least one summary frame
 - 5 comprising one of a past or future frame from said program;
 - 6 a control means for allowing a user to change said video

7 program and for allowing said user to select said at least one summary
8 frame to play at least a segment of said video program corresponding
9 to said selected summary frame.

1 26. A user interactive video viewing system as recited in claim 25
2 wherein said viewing system comprises a television system.

1 27. A user interactive video viewing system as recited in claim 26
2 wherein said summary frames remain on said display screen when said
3 video program is preempted.

1 28. A user interactive video viewing system as recited in claim 26
2 wherein the user can delete said summary frames from said display
3 screen.

1 29. A user interactive video viewing system as recited in claim 25
2 wherein said viewing system comprises client connected to a server.

1 30. A method for informing a viewer of the content of a video
2 program in progress, comprising the steps of:
3 selecting a plurality of summary frames depicting selected
4 events from a video program;
5 embedding said summary frames in said video program;
6 transmitting said video program comprising said summary
7 frames over a media; and
8 displaying said video program and said summary frames on a
9 screen at a same time with said video program when a viewer selects
10 said video program.

1 31. A method for informing a viewer of the content of a video
2 program in progress as recited in claim 30, further comprising the

3 steps:

4 displaying a video segment corresponding to a particular
5 summary frame when said summary frame is selected by a viewer; and
6 resuming said video program when said video segment has
7 finished.

1 32. A method for informing a viewer of the content of a video program
2 in progress as recited in claim 30, comprising the step of continuing to
3 display said summary frames when said video program is preempted.

1 33. A method for informing a viewer of the content of a video
2 program in progress as recited in claim 30, further comprising the steps
3 of:

4 writing selected frames from said selecting step in a row
5 direction of a table;
6 reading said selected frames from said table in a column
7 direction to interleave said summary frames displayed on said screen.

1 34. A method for informing a viewer of the content of a video
2 program in progress as recited in claim 30 wherein said step of
3 displaying said video program comprising said summary frames on a
4 screen comprises placing said video program and said summary frames
5 in designated windows on said screen.

1 35. A method for informing a viewer of the content of a video
2 program in progress as recited in claim 30 wherein said video program
3 and said video program in progress are on different channels.

REMARKS

Claims 1-20 have been canceled. Claims 21-35 are newly presented for examination.

This application is assigned to IBM Corporation as recorded in the parent application.

Briefly, the present invention is directed to a system for placing summary frames into a currently playing video depicting either past or future scenes so that a viewer can get a quick overview of the video program. As explained on page 5 and shown in Figure 1, the summary frames depict key scenes from the past which aid the viewer in quickly ascertaining the current plot or theme of the video program. Hence, when a channel surfer arrives at a new channel, rather than only having what is currently playing to catch the eye, summary frames are also available to catch the surfer's attention and aid in understanding the programming and perhaps hold the viewer's attention long enough to keep him from immediately changing the channel.

In the parent application, claims were rejected as being unpatentable over either Nakagki or Nakagaki in view of Marshall.

The Examiner appeared to appreciate that there were differences between the claimed invention and the prior art but had concerns that, when giving the claims there broadest interpretation, they did not adequately distinguish over the prior art. In particular, the examiner noted that it was not clear from the claims that the summary frames were available for display immediately when the viewer arrives at a particular channel.

To that end, the claims as now presented are believed to make that distinction clear. For example, Independent claim 21 recites "means for selecting a programming channel containing video program in progress; a display screen for viewing a video program in progress; at least one summary frame also displayed on said display screen along with said video program in progress at a same time when said programming channel is selected, said at least one summary frame comprising a past frame from said video program in

progress" (emphasis added).

Similarly, independent claim 25 recites "at least one summary frame displayed on said display screen at a same time with said video program, said at least one summary frame comprising one of a past or future frame from said program" (emphasis added).

Likewise, independent claim 30 recites "displaying said video program and said summary frames on a screen at a same time with said video program when a viewer selects said video program" (emphasis added).

The above highlighted limitations are not taught or suggested by the prior art of record. In particular, the primary reference cited by the Examiner to Nakagaki is directed to a television set which includes a delay circuit ("caching") for recording a television show as it is being watched. This is not related to Applicant's claimed invention.

The Examiner has additionally relied on Marshall for teaching "showing future video clips to a viewer on a display screen". However, Marshall is directed to a preview channel which lists all of the programming currently available and those that will be airing shortly. Most cable and satellite systems have such a channel. Included with each listed programming item may also be a short preview clip of the program selectable by the viewer, thus making Marshall's preview channel user interactive. However, again, this has nothing to do with placing summary frames, either past or future, in a program broadcast to be displayed when a channel surfer arrives at a particular channel.

It is respectfully submitted that neither Nakagaki nor Hamilton, taken alone or in combination, teaches or suggests Applicant's claimed invention and that the claims as presented patentably distinguish over this art.

Examination on the merits, taking the above into consideration is respectfully requested at the earliest possible date.

Please charge any deficiencies in fees and credit any overpayment of fees to Assignee's Deposit Account No. 50-0510 (IBM/Yorktown).

Respectfully submitted,


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APPLICATION
FOR
UNITED STATES
LETTERS PATENT

Applicants: Boon-Lock Yeo and Minerva Ming-Yee
Yeung
For: SUMMARY FRAMES IN VIDEO
Docket No.: YO9-97-348C

SUMMARY FRAMES IN VIDEO

DESCRIPTION

5

BACKGROUND OF THE INVENTION

Field of the Invention

10 The present invention generally relates to placing summary frames in a video and, more particularly, to a system for placing summary frames into a currently playing video depicting either past or future scenes so that a viewer can get a quick overview of the video.

15

Description of the Related Art

20 Television viewers are stymied at the number of viewing choices available these days. Cable television systems typically offer one-hundred or more channels to viewer subscribers. Digital satellite systems make available hundreds of channels for viewing choices. Video signaling over, for example, the Internet, allows interactive viewing and the downloading of video from virtually millions of sites. For better or worse, all of these video and 25 entertainment choices have made couch potatoes, more kindly referred to as "channel surfers", out of many of us.

30 In a typical channel surfing scenario, a surfer, armed with an infrared remote control, sits or lies across the room, carefully aims, and begins repeatedly pressing the "channel-up" or "channel-down" button in the general direction of the television set. A good surfer is oblivious to other viewers in the room and the other viewers are

usually powerless to stop an experienced surfer. A surfer will typically not spend more than two or three seconds on any one channel unless there is something on the screen at that precise moment which is of interest. Channels with 5 commercials currently airing and most movies deemed to be well in progress are surfed over almost instantly with very little pause. Similarly, the two or three seconds that a good surfer typically gives a channel before surfing to the next may be insufficient time to accurately determine the 10 true merit of the programing on the channel.

Based on the above scenario, there is a real need in the art for a system to more accurately inform channel surfers or other video viewers of the contents of the current programming on a particular channel and to offer a 15 quick overview of the video program to get the viewer quickly "up to speed" on programs already in progress.

SUMMARY OF THE INVENTION

20 It is therefore an object of the present invention to provide summary frame windows on the screen of a playing video.

It is yet another object of the present invention to allow a viewer to select one of the summary frames to have a 25 short video clip played on the screen, including the accompanying audio, to get the viewer quickly "up to speed" on programs already in progress.

It is yet another object of the present invention to allow a viewer to quickly jump back to a past segment of a 30 video program to aid in understanding what is presently happening.

According to the invention, various shots or summary

frames are selected from a video prior to broadcast. These summary frames are embedded in the broadcast and appear in a small window on the screen at some point in the future as the video is broadcast. The summary frames depict key 5 scenes from the past which aid the viewer in quickly ascertaining the current plot or theme of the video program. In an interactive television environment, a short video segment may be associated with each shot such that when the shot is selected, the past video segment is played in a 10 larger window on the screen complete with sound. Once the segment is viewed, the video program is rejoined in progress with the viewer having a better sense of what is going on in the video. Hence, when a channel surfer arrives at a new 15 channel, rather than only having what is currently playing to catch the eye, summary frames are also available to catch the surfer's attention and aid in understanding the programming.

In a television broadcast environment, this invention is particularly helpful in the event a preempting commercial 20 is airing when a particular channel is surfed. Since the summary frames remain on the screen, the viewer now has a way to quickly determine what program is playing and if it is worth viewing. Similarly, in the event a program is preempted, for example, for an emergency broadcast or an 25 overtime sports event, summary frames are provided to keep the viewer in touch with the regularly scheduled programming. Similar to a television broadcast, the summary frames may also be embedded in prerecorded media, such as, for example, video tape or video disks.

30 In an interactive video environment (i.e., video signaling, for example, over the Internet), the summary frames may allow for quick hyperlinking to a past even

future portion of the video. Frames hyperlinking to future portions are referred to as preview frames. When a hyperlink summary or preview frame is selected, the video can jump and actually begin playing in its entirety from that point.

5

BRIEF DESCRIPTION OF THE DRAWINGS

10 The foregoing and other objects, aspects and advantages will be better understood from the following detailed description of a preferred embodiment of the invention with reference to the drawings, in which:

Figure 1 is a television channel surfing scenario according to a first embodiment of the present invention;

15 Figure 2 is a computer screen for viewing an interactive video signal;

Figure 3 is a computer display showing a main video playback window and three summary windows;

Figure 4 is a block diagram for video processing at a server for summary display;

20 Figure 5 is a block diagram for video processing at a server for summary extraction and display;

Figures 6A and 6B are candidate summary frames with uniform and non-uniform sampling, respectively;

25 Figure 7 is a diagram showing candidate summary frames with content based sampling;

Figures 8A-C are examples of candidate summary frames selection and display;

Figures 9A-B is a first example candidate summary frame selection/replacement and display, respectively;

30 Figures 10A-B is a second example candidate summary frame selection/replacement and display, respectively;

Figures 11A-B is a third example candidate summary

frame selection/replacement and display, respectively;

Figure 12 is a flow diagram for selecting the summary frames;

Figure 13 is a table of interleaved summary frames; and

5 Figure 14 is a table of second method for interleaving the selection of summary frames.

**DETAILED DESCRIPTION OF A PREFERRED
EMBODIMENT OF THE INVENTION**

10

As used herein, a "video signal" represents both analog and digital video signals. In the case of analog signal, the video signal can be displayed by the existing means of displaying analog signal (e.g., television (TV)). Processing 15 an analog signal is accomplished by first digitizing an analog video signal to a digital video signal, and subsequently processed.

The invention has application in many areas, such as, for example, digital television broadcast, channel-surfing, 20 video-on-demand, digital video disk systems, interactive video playback, Internet video signaling, video databases, and digital libraries. Referring now to the drawings, and more particularly to Figure 1, there is shown a viewer 10 channel surfing the television channels according to a first 25 embodiment of the invention. The viewer 10 is shown sitting across the room aiming a remote control unit 12 at the television set 14. As the channels are changed, a channel identification and audio stereo indicator 16 may be displayed on the screen 18 for a few seconds. In this 30 example, channel 07 is currently broadcasting what appears to be a small passenger jet flying through the clouds. This video scene may not appear at first glance to be of interest

to the viewer 10. Hence, the viewer 10 may be inclined to quickly surf to the next channel.

However, according to the invention, various shots or summary frames are selected from the video prior to broadcast. These summary frames are embedded in the broadcast and appear in a small window as shown on the left side of the screen 18. In this example, three summary frames are shown 20, 22, and 24, respectively. These summary frames depict key scenes from the past which aid the viewer in quickly ascertaining the current plot or theme of the video program. Summary frame 20 shows what appears to be a scene of a girl playing basketball, summary frame 22 shows a man in a suit talking on the phone, and summary frame 24 shows an army soldier talking on a portable phone. Based on this additional information, the viewer 10 has more information on which base his decision to surf to the next channel or to linger on this channel. A short video segment may be associated with each shot such that when the shot is selected, for example by aiming and pointing the remote control or entering a key command on the remote control 12, the past video segment is played in a larger window on the screen complete with audio 28. Once the segment is viewed, the video program is rejoined in progress with the viewer having a better sense of what is going on in the video. Of course, the viewer 10 may select to delete the summary frames from the screen if they wish. Alternatively, the summary screens may automatically disappear from the screen if the channel has not been changed for some time.

Hence, according to the invention, when a viewer 10 arrives at a new channel, rather than only having what is currently playing to catch the eye, the summary frames, 20, 22, and 24, are also available to catch the viewer's

attention and aid in understanding the programming. This is particularly useful in the event a commercial is airing when a particular channel is surfed. Since the summary frames appearing on the screen allows the viewer to determine what 5 program is playing and if it is worth waiting for the commercial to end.

Referring now to Figure 2, there is shown a computer screen displaying a video window 50. In an interactive video environment (i.e., video signaling, for example, over the 10 Internet), the summary frames may allow for quick hyperlinking to a past, and preview frames to a future, portion of the video. In this case, when a hyperlink is selected, the video can jump and actually begin playing in 15 its entirety from that point. For example, as shown in Figure 3, a boardroom meeting video is being viewed. On the lefthand side of the screen, summary screens for three of the speakers at the meeting are displayed, 52, 54, and 56. Clicking on any of these summary frames will hyperlink to 20 that portion in the video and play will begin from that point.

Referring now to Figure 3, an alternative method of displaying a video window 300 together with the summary frames 301, 302 and 303 on a computer screen is shown. Here, 25 the summary frames 301 - 303 are displayed on separate windows from the main video window 300. As before, interactivity in the form of hyperlinking and playback of selected summary frames can be facilitated.

Referring now to Figure 4, a system of processing video 30 signals for summary display is shown. This is a system when the processing of video and embedding of summary is done on a server before the video with summary is sent to the

clients. We use the clients to refer to the devices such as computer or set-top boxes/television which the users employ to receive and/or process the incoming video signal.

At the server 401, video signals 403 are first processed at step 404. At this step, summary frames are extracted. At step 405, the summary frames are embedded with the video signal 403 to a combined video signal 406. Video signal 406 is then either stored back into the server 401 and transmitted through communication channels 402. The channels comprise of satellite networks, cables, and other wired or wireless means of communications.

If the video signal 406 is to be transmitted as a digital signal (such as in Direct TV broadcast or over the Internet), then the summary frames can also be embedded as a digital signal into the video signal 406. If the video signal 406 is to be transmitted as an analog signal (such as in NTBC or PAL broadcast), then the summary frames can be embedded/transmitted using one of several techniques: (i) during the blanking intervals of analog TV signals (ii) allocation of additional frequency spectrum (iii) using a different TV channel (iv) or using separate and different channel for transmission, e.g., through telephone lines. The video signal containing summary frames (406) can be played back on a computer screen 410 of a computer 411. Alternatively, in a broadcast environment, it is received in a set-top box 413, decoded and then displayed on a television screen 412. On the television screen 412, the summary frames are overlaid onto the main TV program.

Referring now to Figure 5, a system of processing video signals for summary extraction and display on the client is shown. A video signal 503 is transmitted through communication channels 502. The signal can either be an

analog signal (such as NTSC or PAL) or digital (such as DirecTV). If the client is a computer 511, then processing of incoming video signal 504 is performed first at step 506. The video signal if in analog form, is first digitized to 5 digital signal. The summary extracted are then displayed at step 507 on a computer display 510. If the client is a set-top box 513 and television set 512, then processing first takes place at 508. Again, if the incoming video signal 505 is analog, it is first digitized. The Summary 10 frames are then displayed at step 509 on a television screen 512. If the television display takes as input analog signals, then the summary frames are converted back to an analog signal and then overlaid on top of the regular TV signal for display. The overlay is performed in the set-top 15 box 513.

The processes of selecting and displaying summary frames is now described. First, summary frames have to be selected to represent different video content. A straightforward method is shown in Figure 6A. A candidate 20 summary frame is taken from the video signal at regular time interval t . A fixed memory buffer in a computing device can be maintained to store the selected frames. The candidate summary frames can show the past content or future content, if appropriate. In a live-broadcast, summary frames of past 25 content can be selected.

In Figure 6B, the frames are selected in a non-uniform manner. At a given current frame, it is desired to select more frames that are closer in time to the current frame and fewer frames that are further in time from the current frame 30 (distant past or distant future). However, given a fixed memory buffer in a computing device, it is difficult to maintain such a structure when the current (reference) frame

is constantly changing.

An alternative method to select the candidate summary frame is based on content-based sampling of video frames, as shown in Figure 7. A candidate summary frame is selected only if it is sufficiently different from the previously selected summary frame, that is, it is a good representative of a contiguous segment of video with similar context. For example, 701, 702 and 703 show three candidate summary frames. Summary frame 703 is selected because its content is sufficiently different from 702.

An example method of displaying the summary frames from those selected in Figure 8A is shown in Figure 8B and 8C. From the current frame, four frames p1, p2, p3, and p4 are selected as summary frames representing the past, and four frames f1, f2, f3, and f4 are selected as summary frames representing the future. In Figure 8B, one method of display the summary frames is shown. Here, the summary frames are overlaid on the top and bottom of the regular display area. The display can be a television display or a computer display. In Figure 8C, another method is shown wherein the summary frames are overlaid in the left and right of the display. The number of summary frames and the overlaid patterns can be varied.

In the method of Figure 6 and 7, there tends to be a lot of repetition in scene structure. The implication is that summary frames selected can be similar in content. Because the display area is limited and the number of summary frames that can be displayed at a time is limited. One method to maximize the use of these resources is to maximize the information that the summary content carries. Thus, the summary frames will better serve this purpose if they show visually differing content, that is, the number of

visually similar summary frames in display should be minimized.

Figure 9 to 11 show examples of candidate summary frame selection, replacement and display method that achieve this effect. In Figure 9A, frames 901, 902 and 903 are the present set of candidate summary frames, designated as p1, p2, and p3 respectively. In Figure 9B, summary frames are displayed in display 900 as shown.

In Figure 10A, as new frames are observed, a new set of candidate summary frames are selected. Here, frames 902 and 903 are replaced because they represent similar content to what frames 905 and 906 respectively represent, i.e., segment b is similar to segment e, and segment c is similar to segment f. The selected frames at this instant are 901, 904, 905 and 906. The summary frames are again designated as p1, p2, p3, and p4, and displayed in Figure 10B. In Figure 11A, the current frame is now at another position. Here, frames 904 and 901 are also replaced because newer frames that are similar are observed. In this case, segment a is similar to segment h, and segment d is similar to segment g. The current set of summary frames is displayed as shown in Figure 11B.

Figure 12 is a flow diagram showing a preferred embodiment for selecting the summary frames (process 404, 506, and 508). As shown in block 30, the set of summary frames is denoted as $S = \{f_{s1}, f_{s2}, f_{s3}, \dots, f_{sL}\}$ where the relationship $s_j < s_{j+1}$ holds. Initially, there are no frames in S, i.e., $S = \{\}$. At block 32, a video is scanned from the first frame for identification of keyframes K_n , that is, initially, the first frame of the video, f_1 , is selected as the keyframe. At block 33, S_{sj} is removed from S if S_{sj} is older than some time t. This ensures that summary frames

displayed on the screen are not too old to be relevant. At block 34, the next frame f_k is scanned selected as the next keyframe K_n if the intensity value is greater than the previously selected keyframe by some predefined threshold:

5 i.e., $d(f_k, K_{n-1}) > \delta$, at decision block 36. Here, $d(,)$ measures the differences in the intensity or other properties of the intensity related measurement between two frames. Examples include histogram and pixel differences, described in Yeo and Liu, "Rapid Scene Analysis from

10 Compressed Video", IEEE Transactions on Circuits and Systems for Video Technology, Vol.5, No.6, pp. 533-544, December 1995, herein incorporated by reference.

At block 38, after a keyframe K_n is identified, it is then decided if it should be added to the set of summary frame S . The decision is made at block 40 as follows: K_n is compared using a difference function $d(,)$ against each frame $f_i \in S$. The one that yields the smallest difference is denoted f_m . If $d(f_m, K_n) < \epsilon$, i.e., if the keyframe K_n and f_m is sufficiently similar, we replace f_m in S by K_n and

15 20 reorder the frames in S by increasing order of frames at block 42. If, on the other hand, this relationship does not hold, and the set S is not full, K_n is inserted into the set anyway, as depicted in block 41. This technique is repeated until the last frame in the video is scanned, at block 44.

25 This technique maintains only those summary frames that are sufficiently different from each other. Similar frames such as different shots of the same talking heads will not be maintained as summary frames. Thus, during the presentation, more different and diverse images can be displayed. This

30 selection scheme is a one-pass scheme.

An alternative embodiment is to replace the frames that have been in set S by the keyframe K_n . This method will

maintain in the set of summary frames those frames that are similar to each other. Thus, in a sequence of alternating shots depicting a conversion between two persons, k few frames portraying each of the persons will be maintain as summary frames.

5 Yet another alternative method to embed summary frames is to make use of results from a shot detection algorithm. An example technique that performs shot detection on MPEG (Motion Picture Expert Group) compressed video is described 10 in Yeo and Liu, *supra*. A summary frame is then selected to represent each shot. This selection scheme is a two-pass scheme.

15 It is desirable to not only allow the user to be able to see summary of video content about some time f prior to the current playback, but also to allow the user to see the summary of the video content about time $2t$, $3t$, prior to the current playback. Referring to Figure 13, to achieve this, a preferred method of selecting summary frames from the set S 20 $= \{f_{s1}, f_{s2}, f_{s3}, \dots f_{sL}\}$ is to interleave the selection of frames. If at each step of embedding, it is desired to select and embed some M frames (assuming M divides L), the set of summary frames are listed or written into a table 50 of width L/M and height M in a row-wise fashion (i.e., place the frames in the first row first, from left to right, then 25 in the second row, and so on), as shown by write arrow 52. In this example, $L=12$, and $L/M=3$. At each step of the embedding, the frames are read off in a next column, as 30 illustrated by read arrow 54. In this manner, we guarantee that each set of M summary frames selected represent video content spanning a longer period of time than mere the most recent M summary. An alternative embodiment is to also embed the summary of video of the future, i.e. about some time t ,

2t, 3t,... after the current playback.

Another method of interleaving the selection of summary frames is shown in Figure 14. Here, the Summary frames are listed row-wise in a triangular structure, i.e., each row 5 has more columns than the previous one. At each step of the embedding, the frames are read off in a column fashion. For example, if each embedding step requires 4 frames, then fs_1, fs_2, fs_4 and fs_7 are first used. At the next step, fs_{12}, fs_{19}, fs_3 and fs_5 are used. This provides a 10 non-uniform sampling in the sense that more summary frames are used that are closer to the current frame, and fewer frames are used that are further from the current frame. This achieves what is presented in Figure 6B.

In an interactive video playback environment, such as 15 the desktop or video streaming, the summary frames displayed with the playback frames can be further used for hyperlinking purposes, i.e., a user could click (or select) frames f_{s_1} and the playback will continue from frame f_{s_1} .

A preferred use of summary-hyperlinking is now 20 described. At the playback of some current shot s_i , the summary frames of the past shots and future l shots are simultaneously shown. The user can then easily see and replay one of the recent l shots or skip to one of the next shots; this is in contrast to the current method of video 25 playback, in which a user can only see the current frame being playback.

Another preferred use of summary-hyperlinking is to 30 embed the summary frames not of the current video being played back, but to embed the summary of video of another program. A user can then click (or choose) to jump to that particular. An example use would be showing the summary of another football game while the video playback is of

another. A user can then watch the current game but also grasp the summary of the other game. He can also switch to the other game directly without the needing to know the channel.

5 For digital video compressed with standards such as MPEG-1 and MPEG-2, a preferred method to embed the summary frames is at the user-data area, which are specified by a particular header. To further ensure that the summary frames from the bitstreams can be extracted and displayed from any 10 point (i.e., not necessarily from the very beginning) in the bitstreams, a new set of summary frame is embedded at fixed intervals T . For an MPEG-1 video (352 by 240 pixels) at 1.5 Mbits/sec, a DC image takes up 1.8 Kbytes. If in one sec, 4 DC images are embedded, then the overhead is $7.2/192$ or 15 3.75% . If instead, 1 DC image is embedded in each second, the overhead is 0.09375% . For an MPEG-2 video (704 by 480 pixels) at 4.0 Mbits/sec, a DC image takes up 7.92 Kbytes. The overhead for embedding 4 DC images/sec is 6.1% and for 20 1 DC image/sec is 1.5% . For higher bit rate MPEG-2 such as 6.0 M bits/sec, the respective overhead becomes 4% and 0.38% . The embedding process operates directly on the compressed video and does not require any decompression, and thus very computationally efficient.

25 While the invention has been described in terms of preferred embodiments, those skilled in the art will recognize that the invention can be practiced with modification within the spirit and scope of the appended claims.

CLAIMS

We claim:

- 1 1. A video viewing system, comprising;
2 a display screen for viewing a video program in
3 progress;
4 at least one summary frame superimposed on said
5 display screen along with said video program in
6 progress, said at least one summary frame comprising a
7 past frame from said video program in progress.

- 1 2. A video viewing system as recited in claim 1
2 wherein said selecting said at least one summary frame
3 displays a video segment on said viewing screen
4 corresponding to said summary frame.

- 1 3. A video viewing system as recited in claim 1
2 comprising a plurality of said summary frames each
3 corresponding to a past frame from said video program
4 in progress.

- 1 4. A video viewing system as recited in claim 1
2 further comprising at least one preview frame
3 comprising a future frame from said video program in
4 progress.

- 1 5. A video viewing system as recited in claim 1
2 wherein selecting said at least one summary frame
3 hyperlinks the video program in progress to begin
4 playing from said selected summary frame.

1 6. A video viewing system as recited in claim 4
2 wherein selecting one of said summary frame and said
3 preview frame hyperlinks the video program in progress
4 to begin playing from said selected one of said summary
5 frame and said preview frame.

1 7. A user interactive video viewing system, comprising:
2 a display screen for viewing a video program;
3 at least one summary frame superimposed on said
4 display screen, said at least one summary frame
5 comprising one of a past or future frame from said
6 program;
7 a control means for allowing a user to change said
8 video program and for allowing said user to select said
9 at least one summary frame to play at least a segment
10 of said video program corresponding to said selected
11 summary frame.

1 8. A user interactive video viewing system as recited
2 in claim 7 wherein said viewing system comprises a
3 television system.

1 9. A user interactive video viewing system as recited
2 in claim 8 wherein said summary frames remain on said
3 display screen when said video program is preempted.

1 10. A user interactive video viewing system as recited
2 in claim 8 wherein the user can delete said summary
3 frames from said display screen.

1 11. A user interactive video viewing system as recited
2 in claim 7 wherein said viewing system comprises client

3 connected to a server.

1 12. A user interactive video viewing system as recited
2 in claim 11 wherein selecting said at least one said
3 summary frame hyperlinks said server to start playing
4 said video from said summary frame.

1 13. A method for informing a viewer of the content of
2 a video program in progress, comprising the steps of:
3 selecting a plurality of summary frames depicting
4 selected events from a video program;
5 embedding said summary frames in said video
6 program;
7 transmitting said video program comprising said
8 summary frames over a media; and
9 displaying said video program comprising said
10 summary frames on a screen.

1 14. A method for informing a viewer of the content of
2 a video program in progress as recited in claim 13,
3 further comprising the steps:
4 displaying a video segment corresponding to a
5 particular summary frame when said summary frame is
6 selected by a viewer; and
7 resuming said video program when said video
8 segment has finished.

1 15. A method for informing a viewer of the content of
2 a video program in progress as recited in claim 13,
3 comprising the steps of:
4 hyperlinking to a corresponding portion in said
5 video program when a particular summary frame is

6 selected by a viewer; and
7 playing said video program from said corresponding
8 portion in said video program.

1 16. A method for informing a viewer of the content of a
2 video program in progress as recited in claim 13,
3 comprising the step of continuing to display said
4 summary frames when said video program is preempted.

1 17. A method for informing a viewer of the content of
2 a video program in progress as recited in claim 13,
3 wherein said selecting step comprises the steps of:

4 scanning a first frame of said video and
5 designating said first frame as a key frame;

6 scanning a next frame in said video;

7 comparing said next frame to said keyframe with a
8 difference function,

9 if a result of said difference function is
10 negative scanning another frame in said video,

11 if said result of said difference function is
12 true, then designating said next frame as said key
13 frame;

14 comparing said key frame with summary frames
15 currently being displayed to find one with a smallest
16 difference; and

17 replacing said one with a smallest difference
18 with said key frame.

1 18. A method for informing a viewer of the content of
2 a video program in progress as recited in claim 13,
3 further comprising the steps of:

4 writing selected frames from said selecting step

5 in a row direction of a table;
6 reading said selected frames from said table in a
7 column direction to interleave said summary frames
8 displayed on said screen.

1 19. A method for informing a viewer of the content
2 of a video program in progress as recited in claim 13
3 wherein said step of displaying said video program
4 comprising said summary frames on a screen comprises
5 placing said video program and said summary frames in
6 designated windows on said screen.

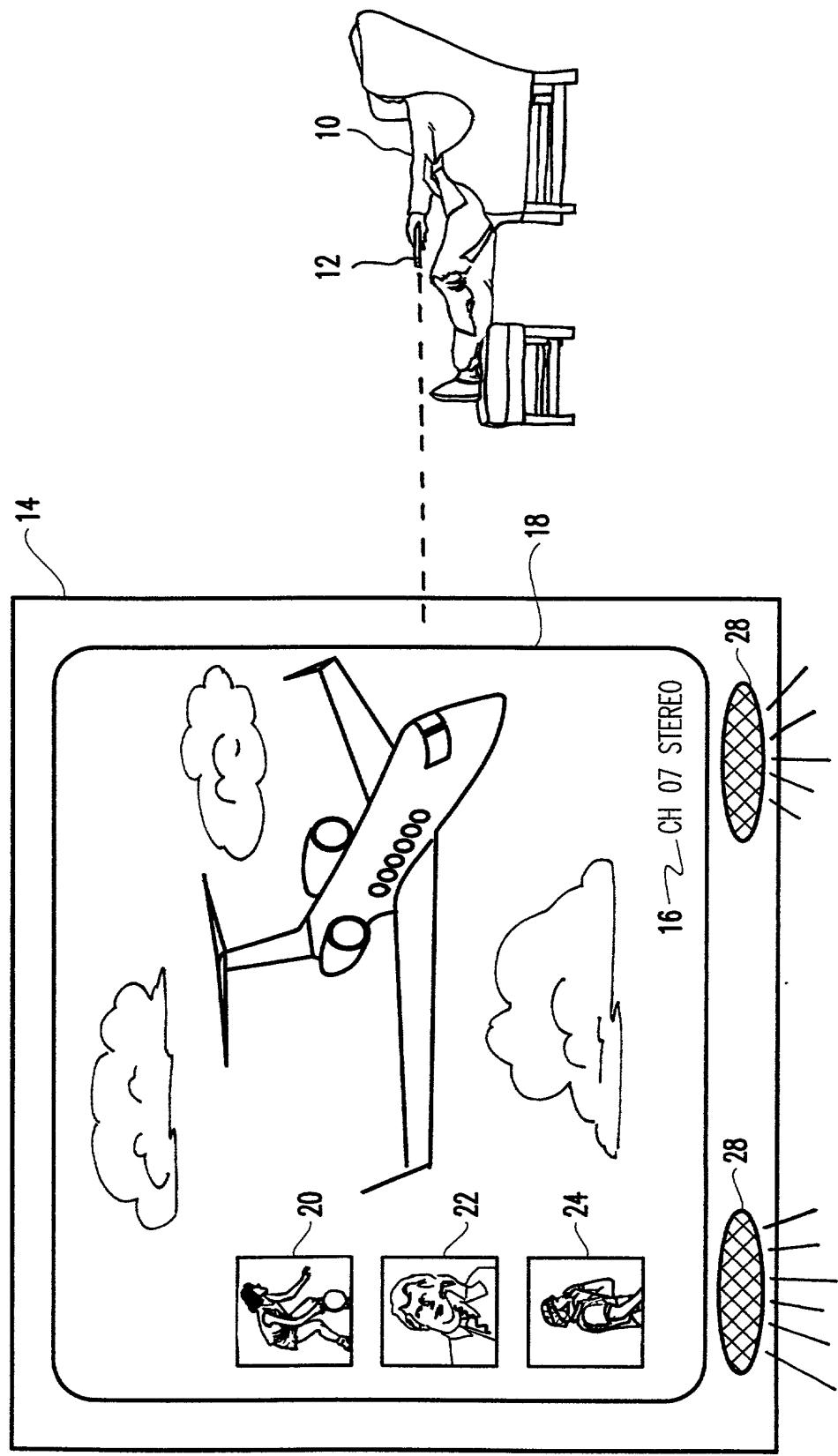
1 20. A method for informing a viewer of the content
2 of a video program in progress as recited in claim 13
3 wherein said video program and said video program in
4 progress are on different channels.

ABSTRACT OF THE DISCLOSURE

5

SUMMARY FRAMES IN VIDEO

According to the invention, channel surfers are aided by summary frames appearing on the screen along with the regular program. These summary frames are embedded in the broadcast and appear in a small window on the screen at some point in the future as the video is broadcast. The summary frames depict key scenes from the past which aid the viewer in quickly ascertaining the current plot or theme of the video program. In an interactive television environment, a short video segment may be associated with each shot such that when the shot is selected, the past video segment is played in a larger window on the screen complete with sound. Once the segment is viewed, the video program is rejoined in progress with the viewer having a better sense of what is going on in the video. Hence, when a channel surfer arrives at a new channel, rather than only having what is currently playing to catch the eye, summary frames are also available to catch the surfer's attention and aid in understanding the programming.



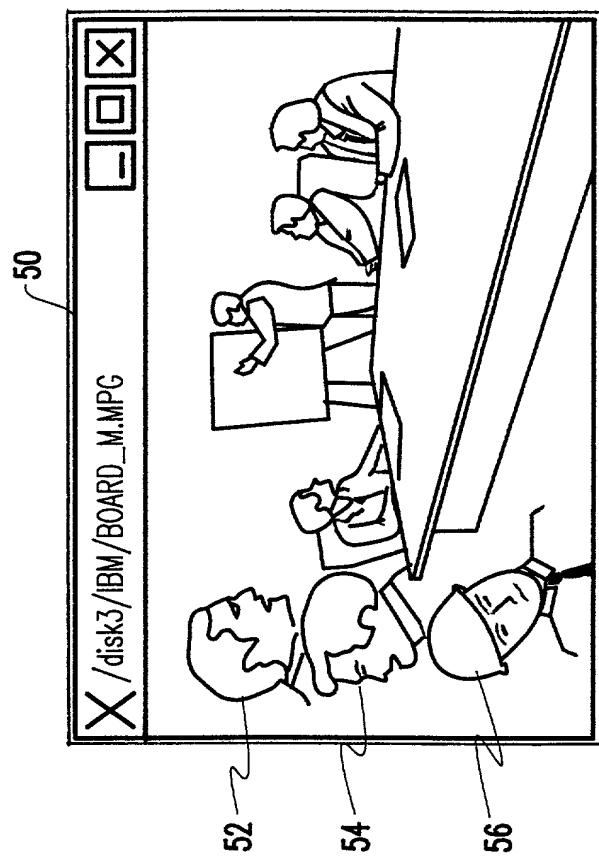
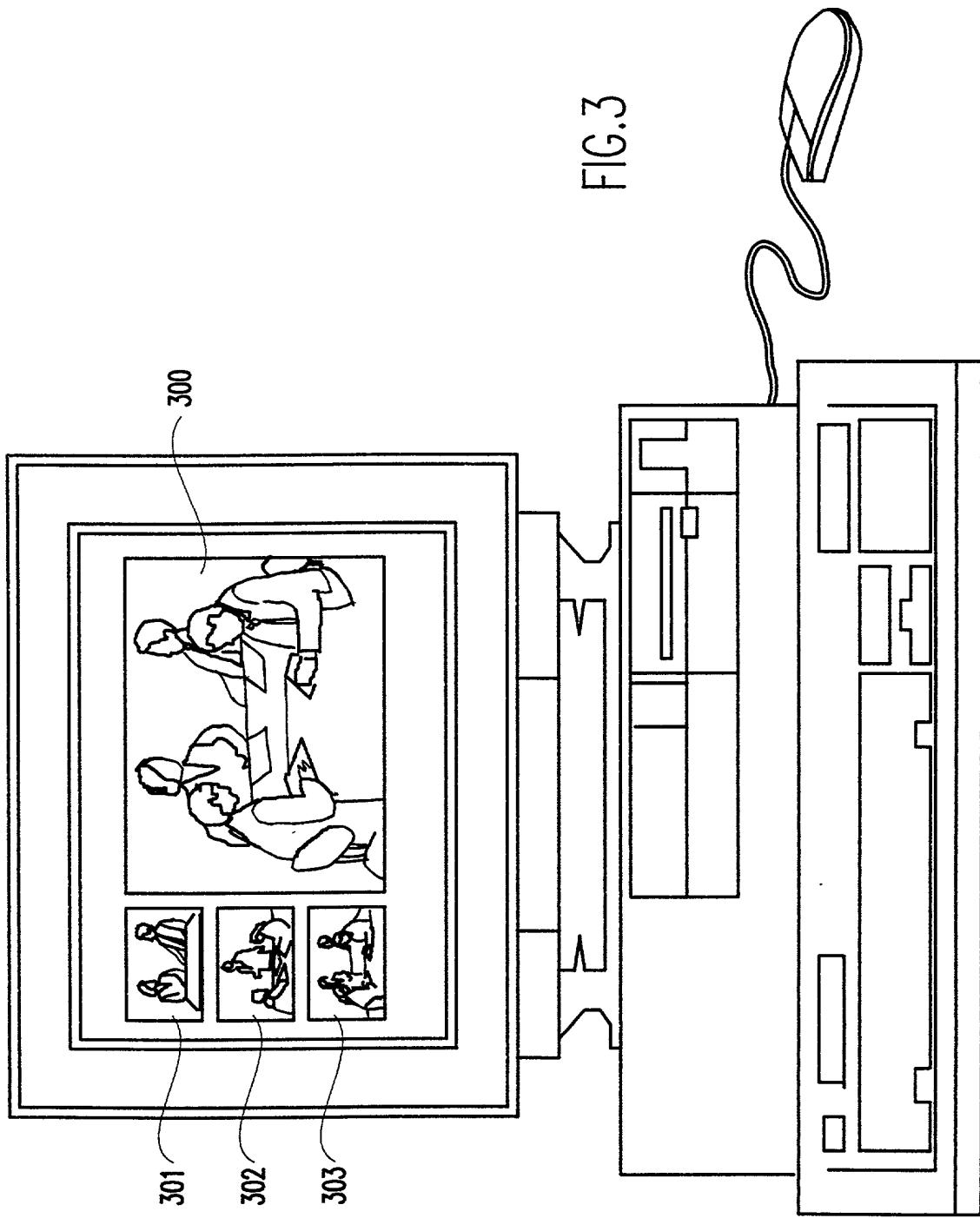
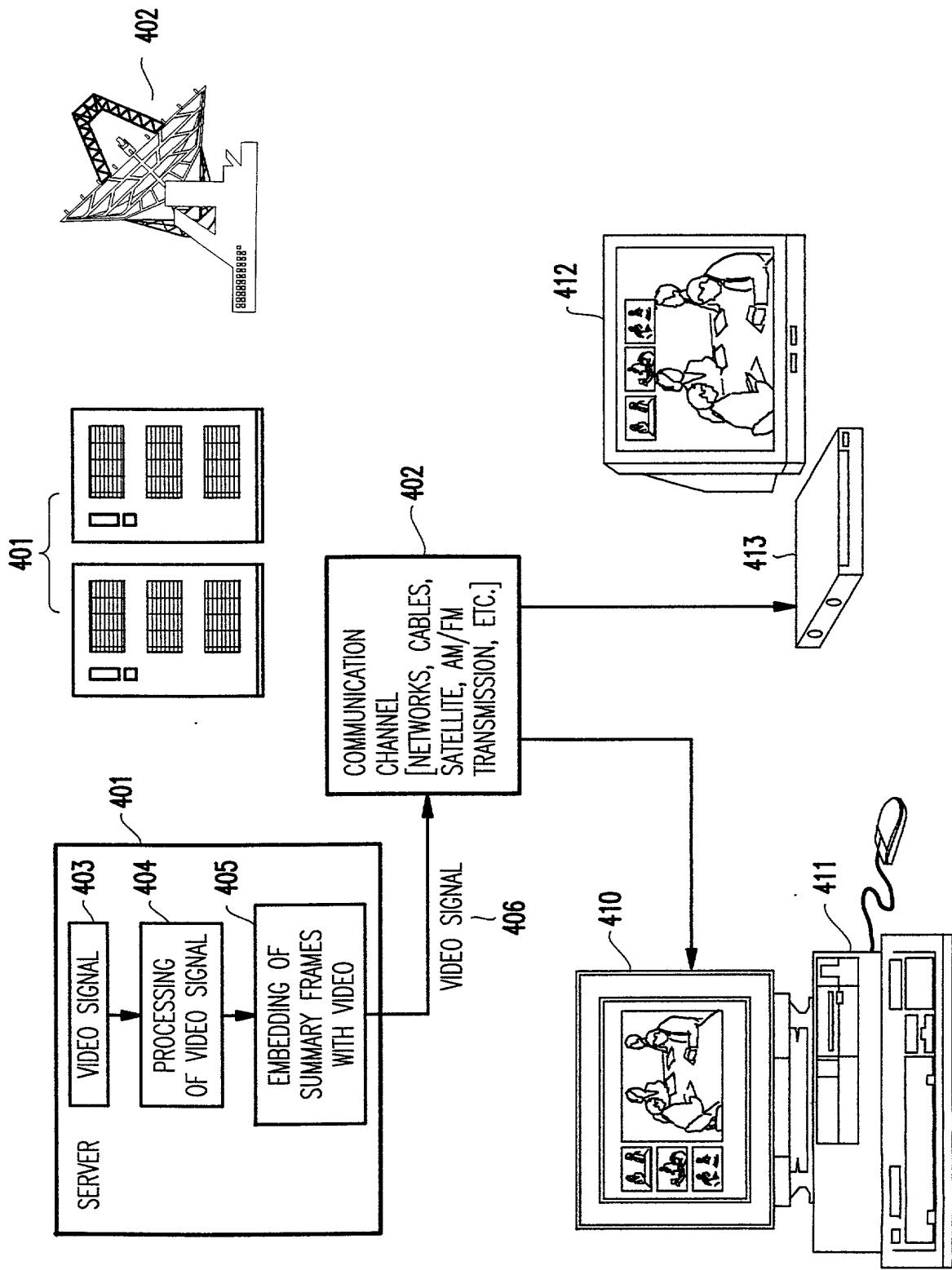
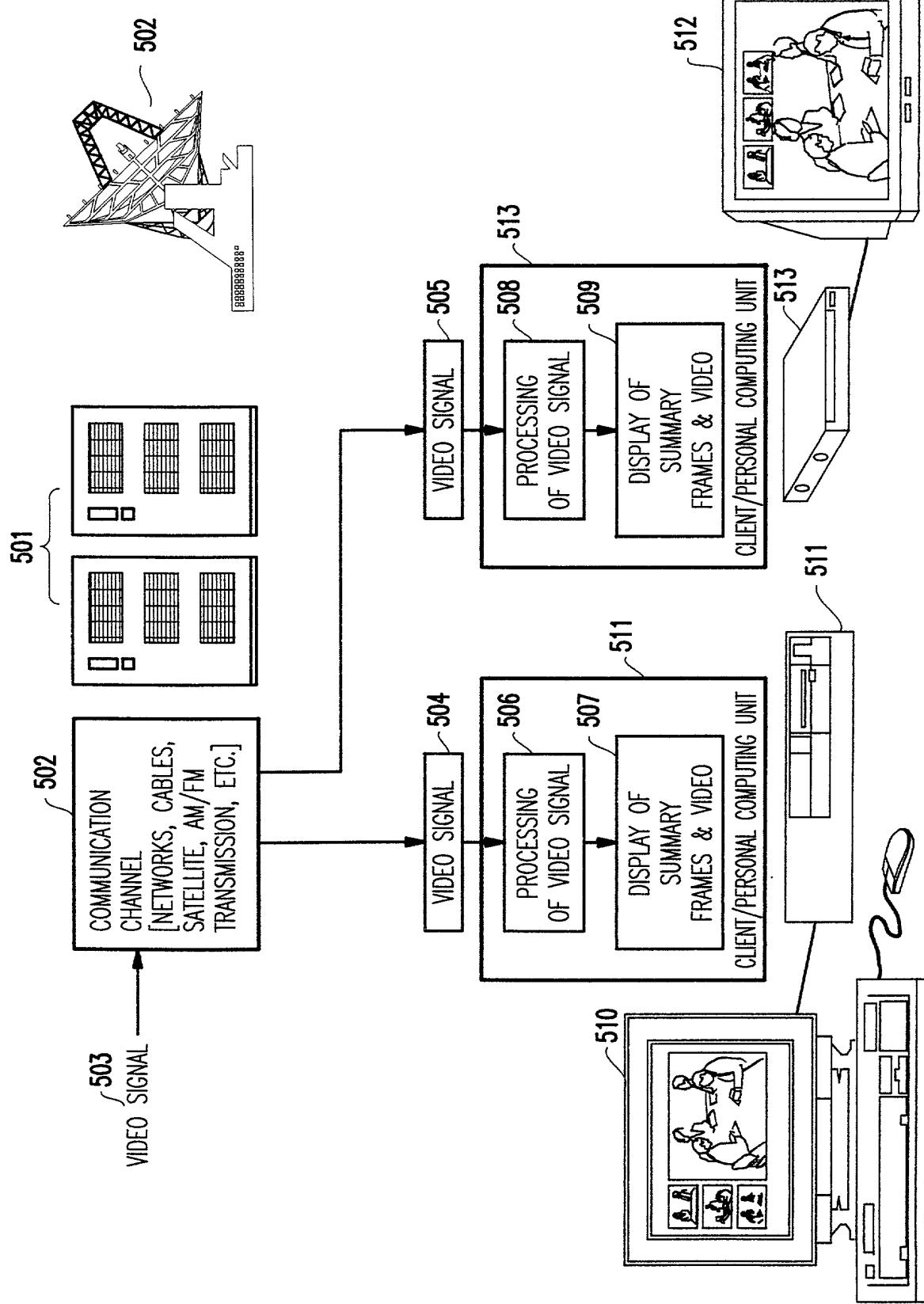


FIG.2

FIG.3







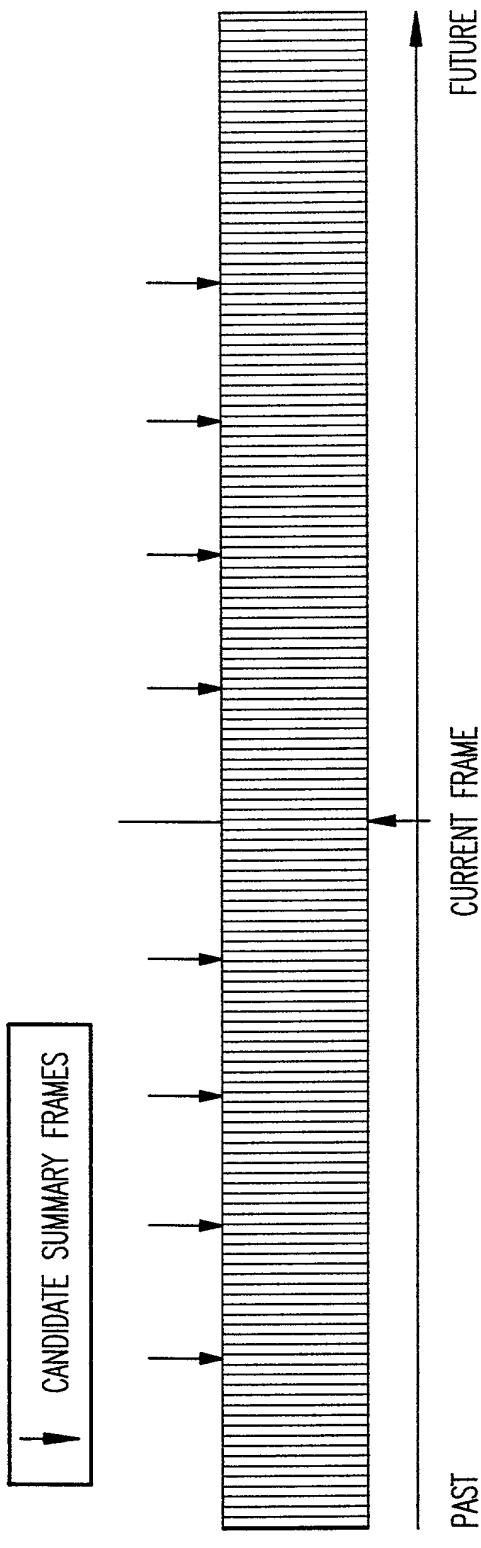


FIG.6A

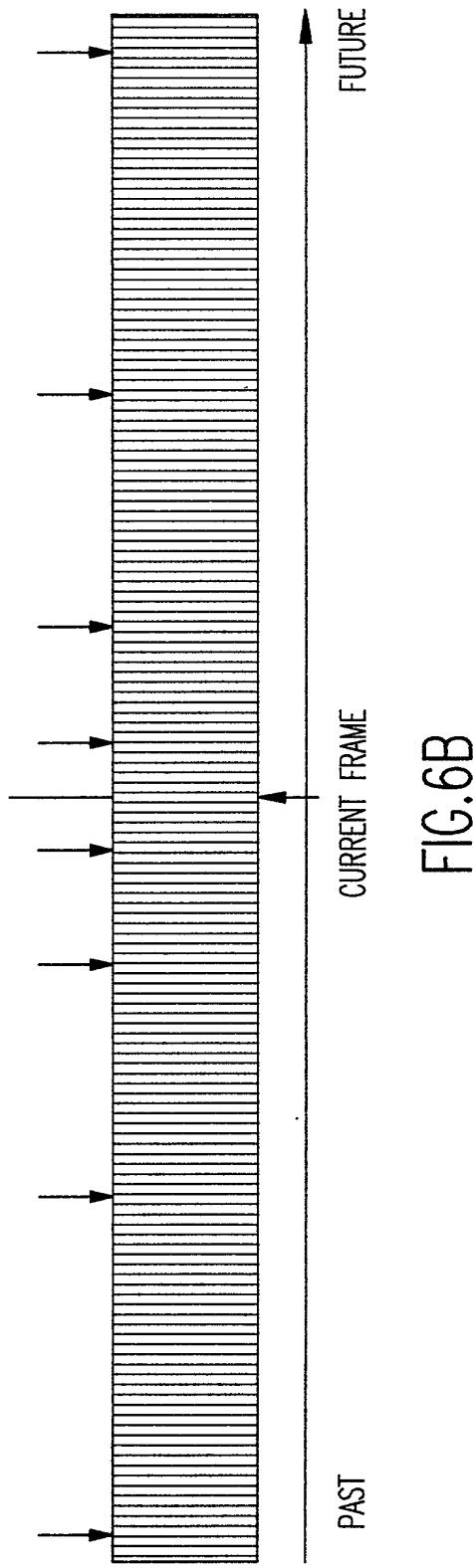


FIG.6B

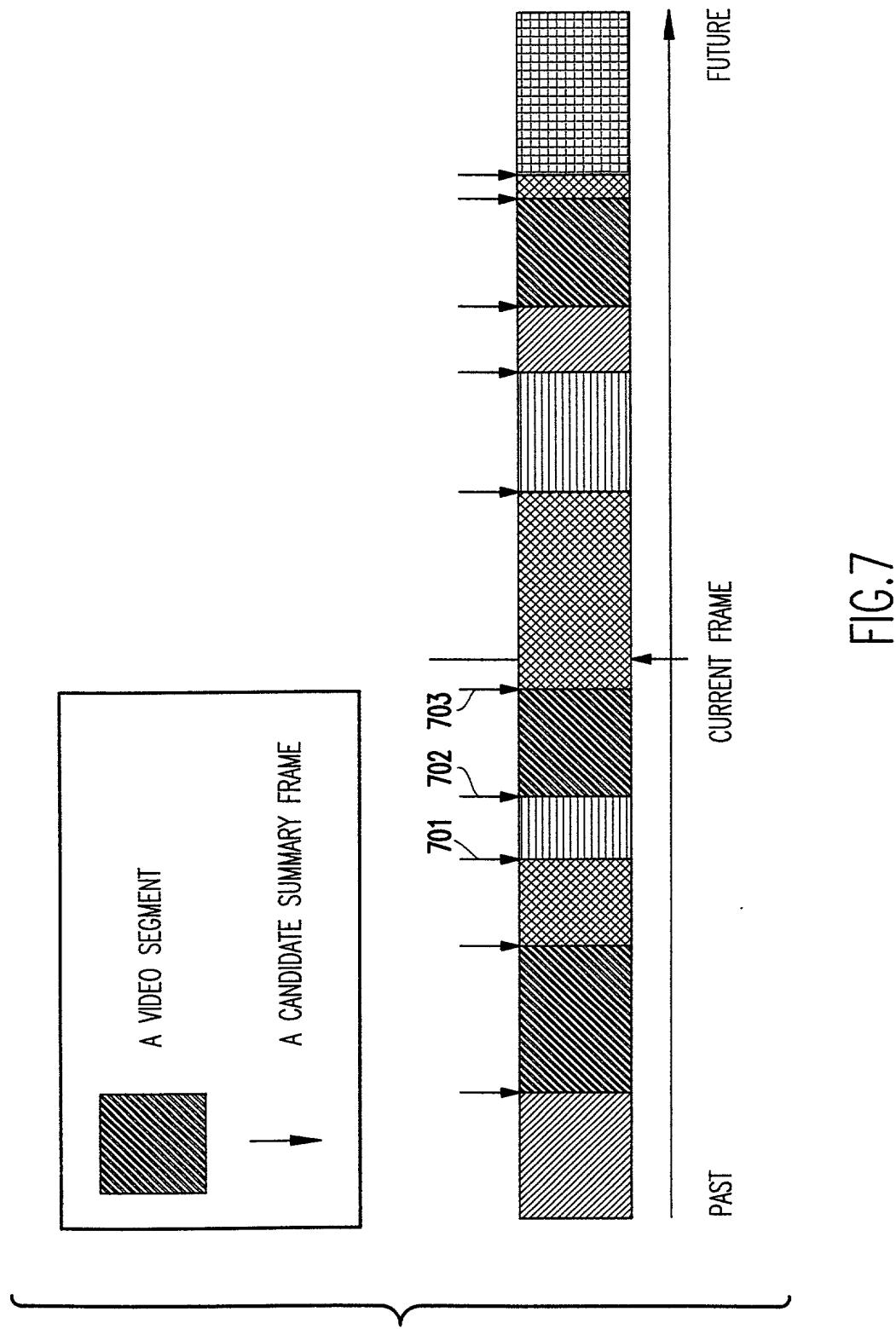


FIG.7

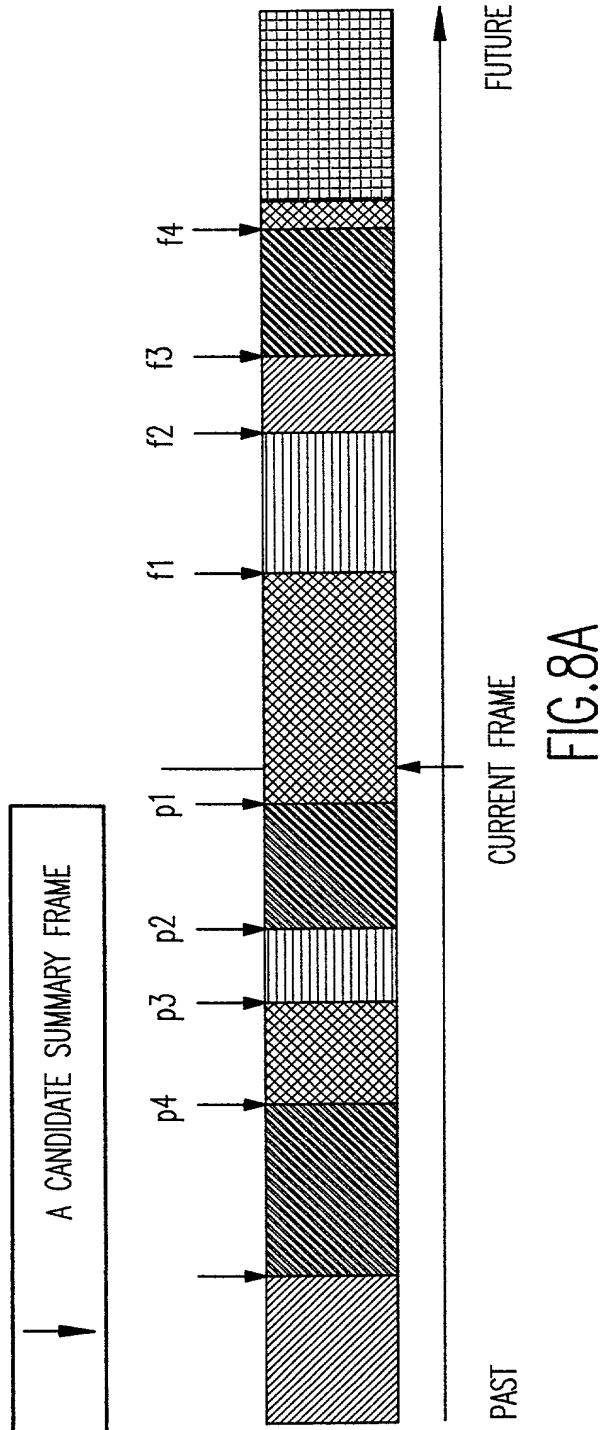


FIG.8A

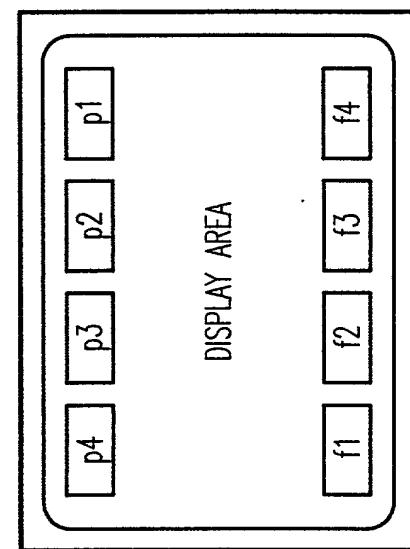


FIG.8B

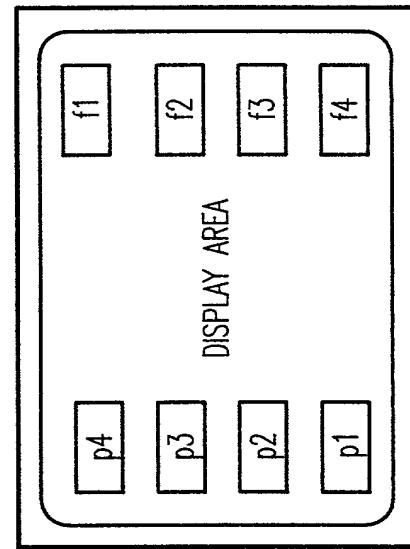


FIG.8C

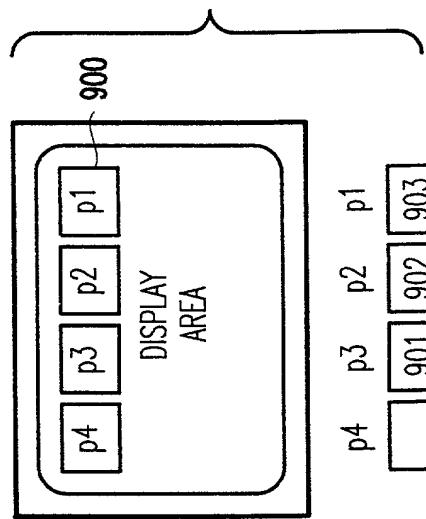


FIG. 9B

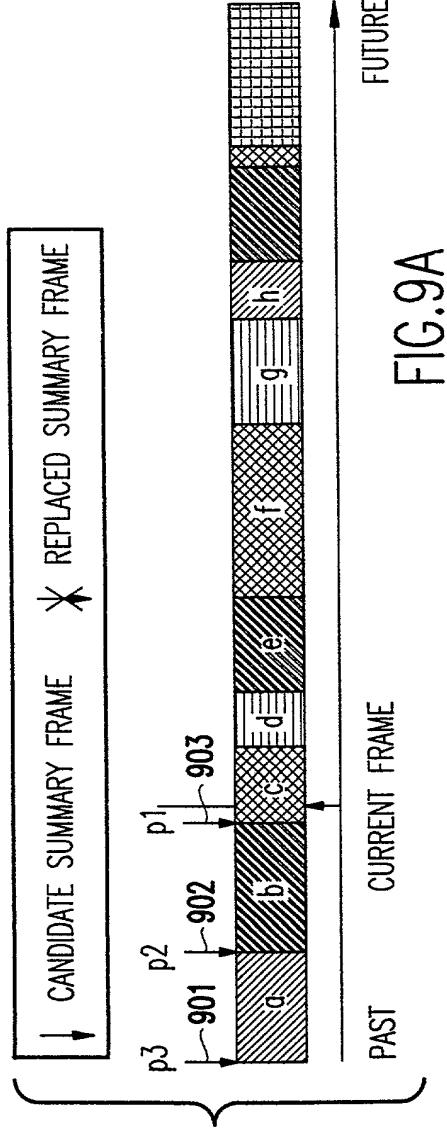


FIG. 9A

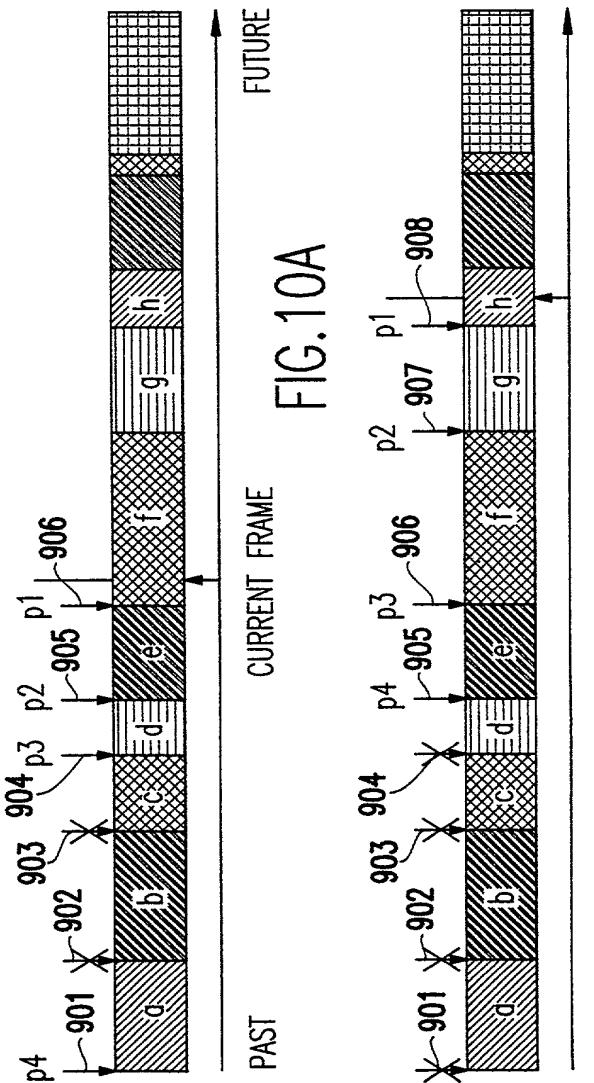


FIG. 10A

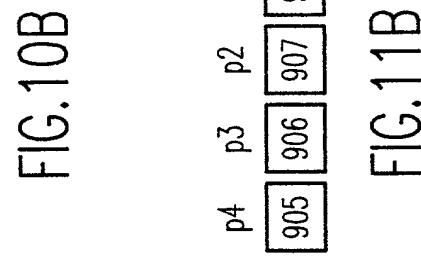
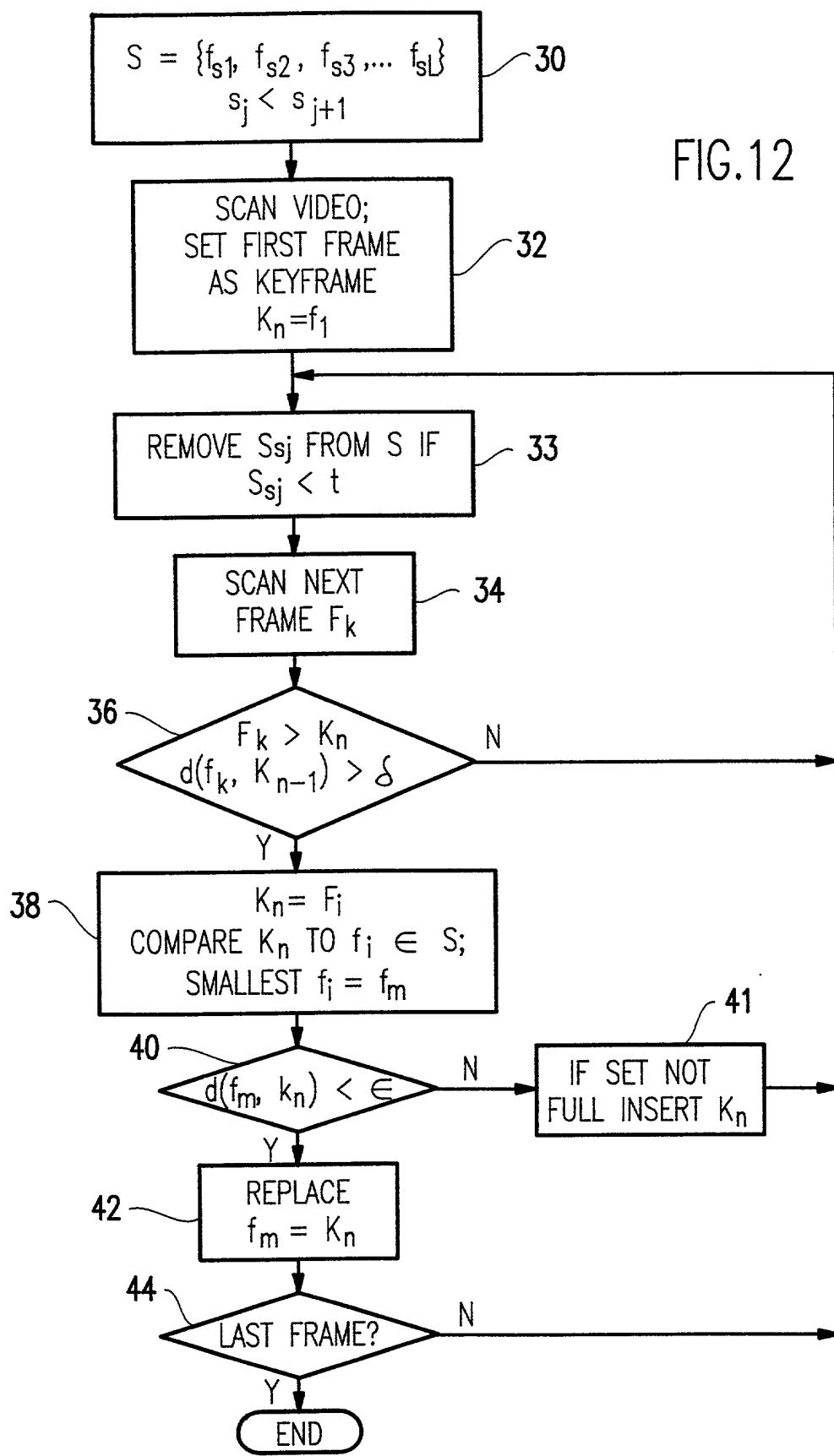


FIG. 11A

FIG. 11B

FIG.12



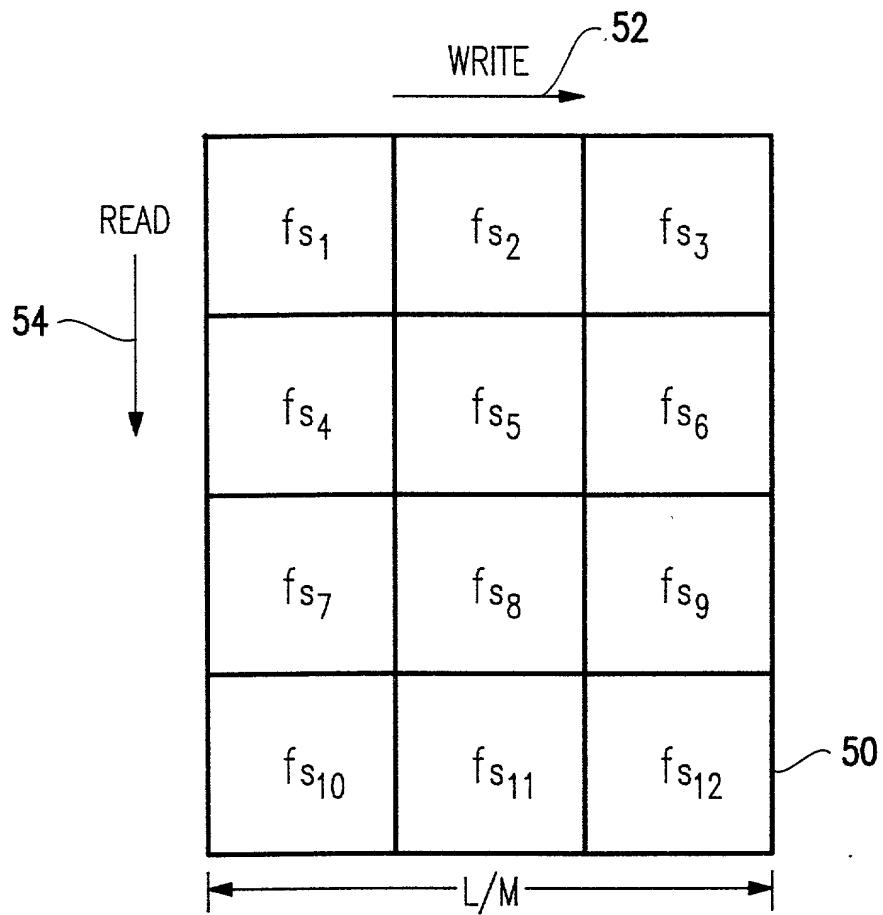


FIG.13

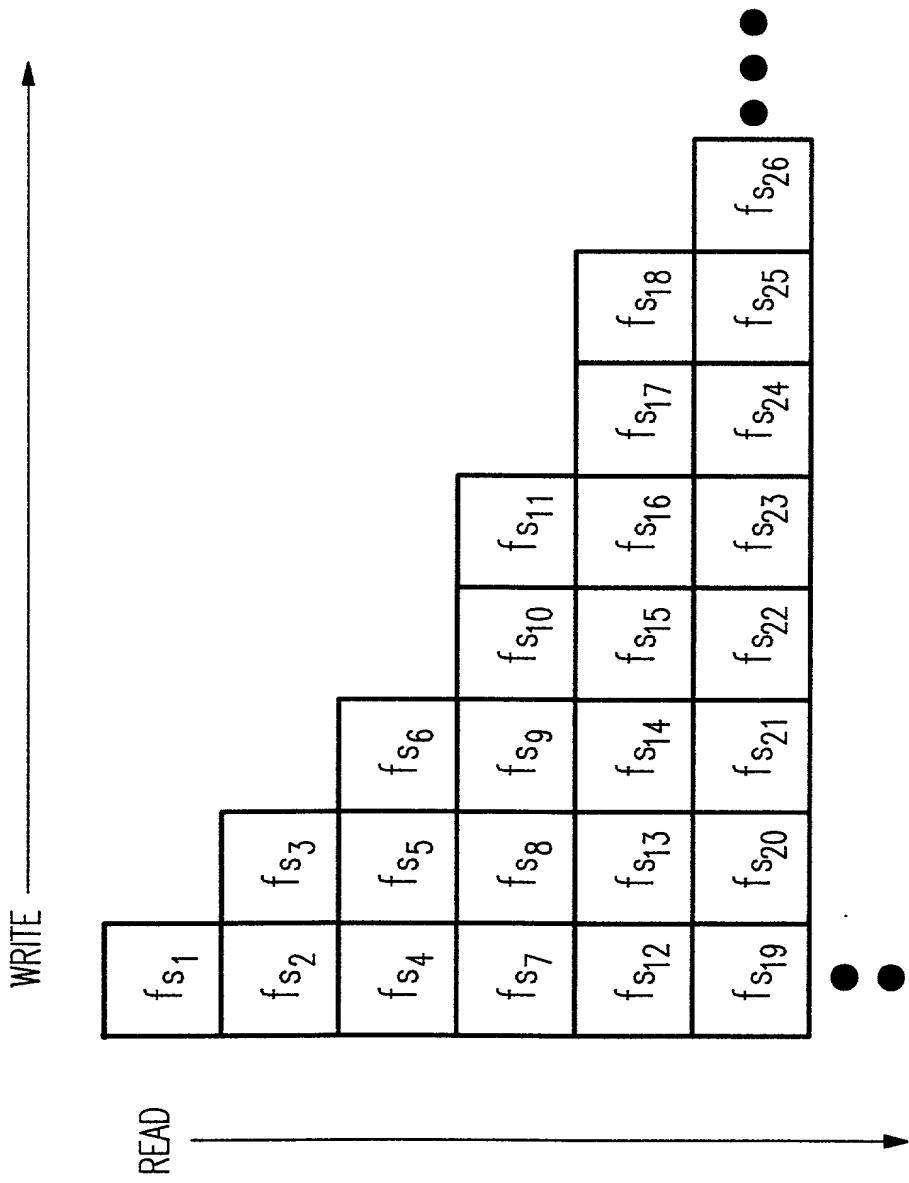


FIG. 14

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

Docket No. Y0997-348

Minerva Ming-Yee Yeung
Full name of second joint inventor, if any

11/7/97

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